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ABSTRACT

This manual is a resource guide on energy conservation for teachers of science students from grades seven to twelve. It contains 12 student activities which are grouped into four goal oriented units. The main objectives of the project are to increase the student's understanding that: (1) Natural laws limit energy availability: (2) Energy consumption affects both man and his environment: (3) Human values and attitudes affect energy usage: and (4) Energy consumption is necessary to maintain our lifestyle. (SB)

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IDAHO
ENERGY CONSERVATION RESOURCE GUIDE
for
SCIENCE GRADES 7-12

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Governor

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"The Energy Crisis can be the most effective teaching aid of the decade."

S. David Freeman
Commissioner
Tennessee Valley Authority

INTRODUCTION

In recent years Idahoans have become increasingly concerned about the energy situation and aware of the importance of energy in our lives. Experts now tell us that unless some immediate steps are taken we will not be able to provide for our future energy needs as a nation. New research and technology can alleviate part of the problem but, more immediately, we must reduce energy use. An effective energy conservation program can result in substantial energy savings, extend the life of present energy supplies, and provide us the much needed time to explore alternatives.

Traditionally, the educational system of our country has been called on to explore and resolve societal problems. The energy situation is a unique opportunity for educators since it reflects a complex set of problems that require changes in values, attitudes and lifestyles. The instructional program in a school can examine these problems and can assist in student awareness of the alternatives and consequences of energy decisions.

This resource guide has been prepared to assist teachers in incorporating energy concerns within the school curriculum. It is intended to provide a basic framework of objectives for different subject areas and to provide examples of activities for teaching towards the stated objectives. Resources are listed to aid the teacher in developing additional activities. It is anticipated that these materials will be a starting point and that teachers will go farther in this important area of instruction.

SCIENCE

Science does not exist in a vacuum; every scientific discovery has the potential to either help or hurt people. Consequently, responsible science education, in addition to teaching content and process, encourages students to examine their values and attitudes toward scientific discoveries.

This guide best supplements general science courses. Teachers of physics, chemistry and life sciences will also find activities to supplement their specialties. While most texts emphasize content and process, this guide emphasizes the importance of human values and of energy conservation.

PROJECT GOALS

This project has four goals. They are easily recalled by the following acronymn:

LUV Energy Conservation

LUV represents the key words in the first three goals.

These key words are:

1. Laws
2. Use
3. Values

The fourth goal is Energy Conservation.

Goal 1. Natural LAWS determine the availability of energy.

There are conditions and limits to our use of energy. Activities under this goal describe what energy is, what forms it takes, and how it can be converted from one form to another. These activities emphasize that all earth's resources are limited.

Goal 2. USE of energy affects both people and their environment.

Everyone depends upon energy. Activities under this goal examine how energy use affects both our natural environment and our economic, political and cultural systems. These activities emphasize that energy use influences the lifestyle for both present and future generations. Lifestyle, in turn, is influenced by our choice of technology.

Goal 3. Our VALUES determine how we use energy.

Energy problems can not be solved by technology alone. Activities under this goal encourage us to analyze our personal energy habits and to accept the responsibility for our actions. They emphasize that changes in energy use and changes in values and attitudes are interrelated. These activities offer us some tools for gathering information, for making decisions, and for providing input to our economic, political and cultural systems.

Goal 4. ENERGY CONSERVATION is necessary to maintain our lifestyle.

There are both long-run and short-run solutions to energy problems. Activities under this goal encourage the development of both new energy sources and of more efficient ways to use energy. They emphasize that energy conservation is an effective and essential tool.

Teacher Note: Use this as a pre and post survey to see if the study of this material has affected change in student attitudes.

ENERGY ATTITUDE SURVEY

1. Do you believe there is an energy shortage? ___yes ___no ___don't know

2. Do you believe you have been given a realistic picture of the energy situation facing the United States? ___yes ___no ___don't know

3. Do you believe most Americans are energy "wasters"? ___yes ___no ___don't know

4. Do you believe most Americans are energy "conservers"? ___yes ___no ___don't know

5. Do you believe Americans are "spoiled", self indulgent and reluctant to take responsibility for the future? ___yes ___no ___don't know

6. Do you believe it is the responsibility of every U.S. citizen to conserve energy voluntarily? ___yes ___no ___don't know

7. Do you believe Americans will conserve energy only when government controls are imposed? ___yes ___no ___don't know

8. Would you be willing to reduce your standard of living to conserve energy? ___yes ___no ___don't know

9. Do you believe you as an individual can make an impact on energy consumption? ___yes ___no ___don't know

10. Would you conserve energy to save money? ___yes ___no ___don't know

11. Do you think the money saved is worth the inconvenience of conserving energy? ___yes ___no ___don't know

12. Do you think the energy saved is worth the inconvenience of conserving energy? ___yes ___no ___don't know

13. Do you feel technology will "bail us out" of the energy shortage? ___yes ___no ___don't know

14. Do you feel you have any input or participation in the energy usage decisions made by your family? ___yes ___no ___don't know

15. Are you going to <u>do</u> something to save energy? ___yes ___no ___don't know

Take a tally for the Energy Attitude Survey and find the percentages for each response.

GOAL 1: NATURAL LAWS DETERMINE THE AVAILABILITY OF ENERGY.

Activity 1

Objective: The student will be able to demonstrate that energy can be transformed from one form to another.

Resources: Library resources - Ask for information using wind energy. Write to:

Public Information Division 3161
Sandia Laboratories
Albuquerque, New Mexico 87115

"Project Weathervane" Pamphlet
Seattle City Light
1015 Third Avenue,
Seattle, Washington 98104

Procedure: This activity can be used to motivate the students to trace power (movement of air) back to its original energy source (the sun) and speculate on further uses of this mechanical energy.

Since energy cannot be created or destroyed, let the students trace the energy pathway backwards as far as they can. We usually regard the sun as the ultimate energy source, but is the sun "creating" energy or just changing its form?

Have the students construct several pinwheels from plastic over-head projector sheets, a pin and a small stick (a pencil will do).

Go outside and demonstrate the production of mechanical energy. Look for the windiest spots on the school-yard and experiment with wind speed at various elevations such as on the fire escapes as opposed to ground level.

The rotating pinwheel is mechanical energy. In what ways can this energy now be used? LET THE STUDENTS USE THEIR IMAGINATIONS.

Discuss the following questions:

1. Can a house be supplied with all its energy from a giant pinwheel?
2. What are some problems involved with wind energy?

Activity 2

Objective: The student will be able to identify different energy sources and analyze their advantages and disadvantages.

Resources: NSTA Energy Factsheets; Library Resources

Procedure: Research the pros and cons of using the different sources of energy.

Hold a class discussion or debate about the energy sources that are most available and appropriate for your area.

Write a report about different energy sources you would consider using in your own home. (Optional - include a sketch of how these would be included in overall house plan).

GOAL 2: USE OF ENERGY AFFECTS BOTH PEOPLE AND THEIR ENVIRONMENT.

Activity 1

Objective: The student will be able to list and evaluate the efficiency and appropriateness of different uses of petroleum and natural gas.

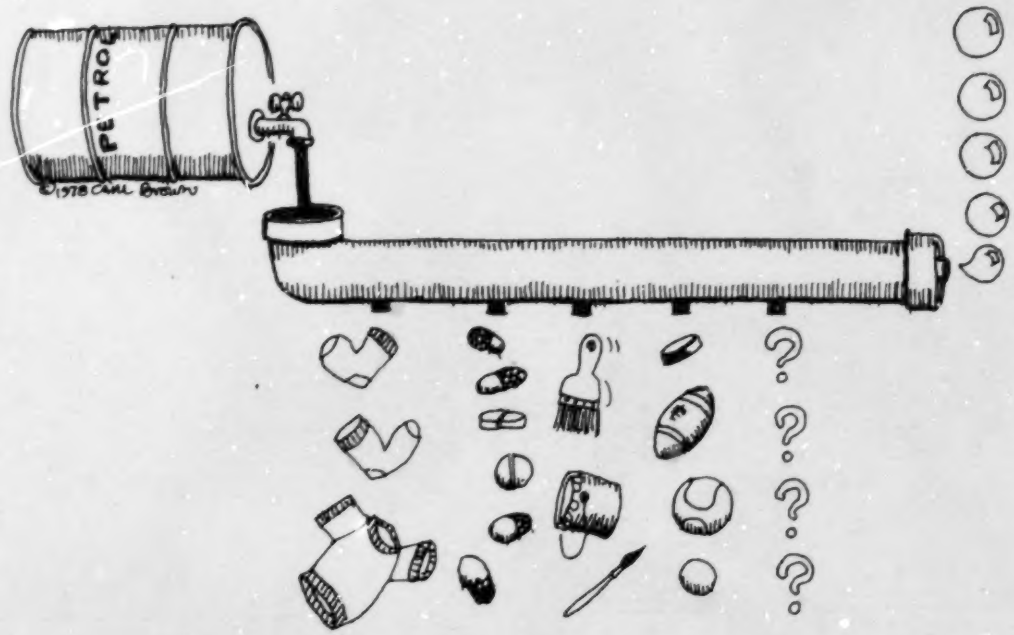
Resources: Library Resources

Procedure: As a homework or library assignment, ask students to find the names of at least ten chemical substances that are made completely, or partially, from the basic resources of petroleum and/or natural gas. Urge them to go beyond common substances such as gasoline and other petroleum distillates to plastics, fibers, drugs, fertilizers, pesticides and other organic compounds synthesized from hydrocarbon compounds.

Develop on the chalkboard a list of at least 50 substances they have found to come from hydrocarbon sources. Discuss the importance of these substances in the lives of individuals or the economic welfare of a country.

Discuss the idea that petroleum is much too important a substance to burn for heat when it appears to be irreplacable for future generations as a basic ingredient in organic chemistry.

Is it necessary and/or desirable for the modern technological world, particularly the United States, to change its life style to conserve more of this resource?



Activity 2

Objective: The student will be able to compare the cost of various fuels in heating space.

Resource: Community Resources (fuel companies, utilities)

Procedure: Determine cost of various fossil fuels in your area; compare with cost of electrically produced BTUs.

Activity 3

Objective: The student will be able to compare energy costs of various types of food packaging.

Resource: Community Resources

Procedure: Visit a bottling company, determine average life of bottle, compare cost with aluminum beverage container.

Activity 4

Objective: The student will be able to contrast the energy efficiency of various modes of transportation.

Resource: NSTA Transportation and the City

Procedure: "Getting There" activity; Transportation and the City

Calculate cost of students driving to school in cars compared with riding school bus.

Activity 5

Objective: The student will be able to demonstrate the correlation between population growth and resource consumption.

Resource: Library Resources

Procedure: Most students readily comprehend that there is a correlation between population and resource consumption: however there is much confusion and contradictory evidence as to how the population of the United States is changing. Some groups claim that we have achieved zero population growth, others claim various rates of growth. It is worthwhile for students to try to determine the growth rate for the U.S. (and perhaps other countries).

You will need the latest figures for;
- birth rate
- death rate
- number of immigrants
- number of emigrants
- total population

Review with the class the following:

The birth rate is the ratio of all births to the total population, in a specific year, multiplied by 1,000.

$$\text{Birth rate} = \frac{\text{Number of births per year}}{\text{Population}} \times 1{,}000$$

The death rate is the ratio of all deaths to the total population, in a specific year, multiplied by 1,000.

$$\text{Death rate} = \frac{\text{Number of deaths per year}}{\text{Population}} \times 1{,}000$$

The growth is the ratio of the difference between the birth and deaths plus the difference between the number of immigrants and emigrants to the total population, in a specific year, multiplied by 1,000. The result is divided by 10 to obtain the rate as a percent.

Part B.

$$\text{Growth Rate} = \frac{\dfrac{(\text{births}-\text{deaths}) + (\text{immigrants}-\text{immigrants})}{\text{Population}}}{10} \times 1{,}000$$

Doubling time is the number of years needed to double the original population size; this depends on a country's rate of population growth. If the growth rate were to remain constant, the following doubling times could be expected:

growth rate	doubling rate
1%	70 years
2%	35 years
3%	23 years

To estimate doubling time, divide the number 70 by the growth rate.

When students have finished calculating growth rate for the U.S., make some calculation for rates of resource use.

List examples of restraints that might result from over-population.

Describe implications for the quality of life under severly restricted energy resource conditions.

List energy related services that would need to be instituted, and those that would have to be abandoned, as a result of overcrowding.

GOAL 3: OUR VALUES DETERMINE HOW WE USE ENERGY.

Activity 1

Objective: The student will be able to analyze his/her own values about the risks of nuclear energy.

Resources: NSTA Energy Fact Sheets
Library Resources
Nuclear Power and the Environment: Questions and Answers
The American Nuclear Society
244 East Ogden Avenue
Hinsdale, Illinois 60521

Procedure:

Part 1 Review with the class the sources of radiation energy to which they are exposed in their environment. Cosmic rays, X-rays, television sets, and microwave ovens will probably be cited by students.

Discuss the fact that small amounts of radioactive materials are found in common rocks, in building materials, in air, food and water. If possible demonstrate the existence of background radiation in the air or rocks or building materials with a sensative Geiger counter.

Using the table below, ask students to calculate the millirems of radiation they receive from common sources in a year. Are they worried about this condition? Should they be worried about radiation from nuclear power plants? Why or Why not?

	Common Source of Radiation	Your annual Inventory
Where you live	Location: Cosmic radiation at sea level add 1 for every 100 feet of elevation	40 ___
	House Construction: Wood 35; Concrete 45; Brick 45; Stone 50	
	Ground: (¼ time factor): U.S. Average	15
What you eat, Drink & Breathe	Water, Food and Air: U.S. Average	25
How you live	Jet Airplanes: Number of 6000 mile flights ___ X 4.	___
	Television Viewing: Black & White: Number of hours per day _____ X 1	___
	Color: Number of hours per day _____ X 2	___

X-ray diagnosis and treatment:
Chest X-ray_____ x 100-200 _____
Gastrointestinal tract X-ray ____ x2000 _____
Dental X-ray _____ x 20 _____

Compare your annual dose to the U.S. annual average of 225 Sub Total _____mrem

HOW CLOSE YOU LIVE TO A NUCLEAR POWER PLANT

At site boundary: Annual average number of hours per day ____ x 0.2 _____
One mile away: Annual average number of hours per day _____ x 0.02 _____
Five miles away: Annual average number of hours per day _____ x 0.002 _____
Over five miles away: none

Total _____mrem

One mrem per year is equal to:
moving to an elevation 100 feet higher
increasing your diet by 4%
watching one additional hour of black and white TV per day
taking a 4-5 day vacation in the Sierra Nevada Mountains

Part 2 Research the potential dangers of nuclear reactors. Be sure to distinguish between conventional reactors and breeder reactors

Magazines
Newspapers
NSTA Fact Sheets

Part 3 Hold a class discussion or debate on the pros and cons of building a nuclear reactor in your community. Then hold a class vote on whether or not to allow the reactor to be built.

GOAL 4: ENERGY CONSERVATION IS NECESSARY TO MAINTAIN OUR QUALITY OF LIFE

Activity 1

Objective: The student will be able to determine the light needed for living tasks.

Resource: Energy Conservation in the Home

Procedure: Check lighting used in rooms, halls at school; also in room at home to determine if more than necessary lights are being used. Plan and implement ways to save energy used for lighting.

Energy Conservation In the Home Activity E:
Fluorescent Lighting: PGE
Fluorescent vs. Incandescent Lighting

Activity 2

Objective: The student will be able to determine the effects of insulation.

Resource: Fish tank thermometer, hot water, insulation, box

Procedure: Float an inexpensive fish tank thermometer in a glass of hot water or coffee. Read the temperature every five minutes and record how rapidly it falls toward room temperature.

Have your students help you make a graph of temperature vs. time on the blackboard. Now put a fresh glass of hot water or coffee inside a box and pack cotton balls, fiberglass insulation, or crumpled paper around it.

Make a graph of temperature against time as before and compare with the previous case; the effects of the insulation should be obvious.

Activity 3

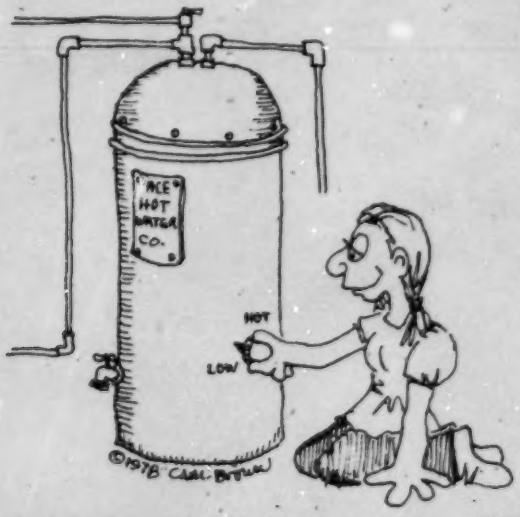
Objective: The student will be able to list electrical appliances and determine energy savings by eliminating non-essential appliances.

Resources: Paper, pencil, home appliances

Procedure: Each student should make a list of all the appliances in his/her home that consume electricity. This inventory sheet should show the appliance, the wattage and the hours it is used per 24-hour day. The student should compile his/her information with the total classroom and develop a composite picture. Parents might be consulted on what appliances they consider to be priority and those that they could get along without.

Students make a pre-test of the kilowatt hours used by the home and then have their families eliminate the usage of all non-priority appliances. The students should then take a post-test reading for 24 hours during this period of the priority-only usage.

Students develop graphs and charts showing the change from the original average per family to the savings by the elimination of non-essential appliances.



Activity 4

Objective: The student will be able to determine benefits resulting from energy conservation.

Resources: Library resources

Procedure: Point out a few of the extra benefits which result from energy conservation. For example, the reduction of the speed limit to 55 miles per hour has, in most states, reduced the number of accidents and deaths on the highways.

Have students suggest other measures which have produced, or might produce additional sociological benefits.

GLOSSARY

ACCELERATION. The time rate of change of velocity in either speed or direction.

ALTERNATING CURRENT (AC). An electric current whose direction of flow is changed at periodic intervals (many times per second).

ATOM. The smallest particle of an element which can enter into a chemical combination. All chemical compounds are formed of atoms, the difference between compounds being attributable to the nature, number, and arrangement of their constituent atoms.

ATOMIC ENERGY. The constitutive internal energy of the atom which was absorbed when it was formed; Energy derived from the mass converted into energy in cuclear transformation.

BLACKOUT. A total power failure unintentionally caused by storm damage, equipment failure, or overloaded utility equipment. An exceptional situation in which all power is deliverately cut off by electrical generating facilities.

BLANKET INSULATION. Cotton fiber, mineral wool, or wool fiber made into varying thicknesses in a length.

COAL. Solid, combustible, organic hydrocarbon formed by the decomposition of vegetable material without free access to air.

COAL GASIFICATION. The conversion of coal to a gas suitable for use as a fuel.

COMBUSTION. Burning; technically, a rapid oxidation accompanied by the release of energy in the form of heat and light. It is one of the three basic contributing factors causing air pollution. The other are attrition and vaporization.

COMFORT ZONE. The proper temperature, humidity, and air movement to create a feeling of comfort.

CONDUCTOR (ELECTRICAL). A material capable of carrying an electrical current.

CONSERVATION. The care or management of natural resources.

CONSERVATION OF MATTER AND ENERGY (LAW OF). The sum of the potential and kinetic energy of an ideal energy system remains constant.

CONSERVE. To manage or use wisely.

CONVECTION. The transfer of energy by moving masses of matter, such as the circulation of a liquid or gas.

CONVENTIONAL HYDROELECTRIC PLANT. A hydroelectric power plant that utilizes streamflow only once as the water passes downstream, as opposed to a pump-storage plant which re-circulates all or a portion of the streamflow in the production of power.

CRUDE OIL. Liquid fuel formed from the fossils of animals and plants; petroleum as it comes from the ground.

CURRENT (ELECTRIC). The rate of transfer of electricity.

CURTAILMENT. Cutting back the use of energy resources as opposed to conserving or wisely using energy resources.

DIRECT CURRENT (DC). An electric current that flows in only one direction through a circuit.

DIRECT ENERGY CONVERSION. The process of changing any other form of energy into electricity without machinery that has moving parts. For example, a battery changes chemical energy into electricity by direct energy conversion.

DOUBLE GLAZED WINDOW. Two panes of glass factory-sealed together with a small air space between them. Double glazing has about twice the R-value of single glazing.

EFFICIENCY. The ratio of the useful work performed to the amount of energy used in the process.

ELECTRICAL ENERGY. The energy associated with electric charges and their movements. Measured in watt hours and kilowatt hours. One watt-hour equals 860 calories.

ELECTROCHEMICAL CELL. A cell in which chemical energy is converted to electric energy by a spontaneous oxidation-reduction reaction.

ELECTRON. The electron is a small particle having a unit of negative electrical charge, a small mass, and a small diameter. Every atom consists of one nucleus and one or more electrons.

ELEMENTS. Elements are substances which cannot be decomposed by the ordinary types of chemical change, or made by chemical union.

ENERGY. The capability of doing work. Potential energy is energy due to position of one body with respect to another or relative parts of the same body. Kinetic energy is due to motion.

ENTROPY. Entropy is the capacity factor for isothermally unavailable energy. Every spontaneous process in nature is characterized by an increase in the total entropy of the bodies concerned in the process.

ENVIRONMENT. The sum of all external conditions and influences affecting the life, development, and ultimately the survival of an organism.

FISSION. A nuclear reaction from which the atoms produced are each approximately half the mass of the parent nucleus. In other words, the atom is split into two approximately equal masses. There is also the emission of extremely great quantities of energy since the sum of the masses of the two new atoms is less than the mass of the parent heavy atom. The energy released is expressed by Einstein's equation, $E = Mc^2$.

FLYWHEEL. A method of energy storage working on the principle of a spinning wheel. By its inertia, a spinning wheel stores mechanical energy.

FOAM INSULATION. (1) Styrofoam; (2) Rigid foam boards; or (3) Liquid foam insulation.

FOSSIL FUELS. Coal, oil, natural gas, and other fuels originating from geologic deposits of ancient plant and animal life depending on oxidation for release of energy.

FUEL. A substance used to produce heat energy, chemical energy by combustion, or nuclear energy by nuclear fission.

FUEL CELL. A device in which fuel and oxygen are combined to produce chemical energy that is converted directly into electricity.

FUSION (ATOMIC). A nuclear reaction involving the combination of smaller atomic nuclei or particles into larger ones with the release of energy from mass transformation. This is also called a thermonuclear reaction by reason of the extremely high temperature required to initiate it.

FUSION. A reaction in which light nuclei combine to form an atom with greater mass.

GAS. A state of matter in which the molecules are practically unrestricted by cohesive forces. A gas has neither definite shape nor volume.

GASOLINE. Mixture of hydrocarbons obtained from petroleum.

GENERATOR. A device that converts heat or mechanical energy into electrical energy.

GEOTHERMAL. As applied to power generation, the use of heat energy obtained through the medium of hot water or steam coming from beneath the earth's surface.

GEOTHERMAL ENERGY. The heat energy available in the earth's subsurface believed to have been produced by natural radioactivity. The thermal gradient of the earth's crust is such that the temperature in a deep well or mine increases by about $1^{o}F$ for each 100 ft. of depth.

GRAM. A unit of mass in the metric system; 10^{-3} standard kilogram.

GREENHOUSE EFFECT. A method of using solar radiation to warm underheated areas (window treatments are opened to allow the window to admit and trap the sun's heat).

GROSS NATIONAL PRODUCT (GNP). A measure of economic activity which is the total market value of all goods and services produced in a country. Depreciation and other allowances for capital consumption are not deducted.

HEAT. Energy possessed by a substance in the form of kinetic energy, usually measured in calories or, in space heating, by the British thermal unit. Heat is transmitted by conduction, convection, or radiation.

HEAT CAPACITY. That quantity of heat required to increase the temperature of a system or substance one degree of temperature. It is usually expressed in calories per degree Celsius.

HEAT ENERGY. Energy that causes an increase in the temperature of an object. It may change the object from solid to liquid or from liquid to gas.

HEAT PUMP. A device that absorbs heat from the outside air and pumps it into the house. It works in reverse as a standard air conditioner for cooling.

HORSEPOWER. A unit that measures the rate at which energy is produced or used. A man doing heavy manual labor produces energy at the rate of about .08 horsepower.

HYDROELECTRIC PLANT. An electric power plant in which the turbine-generators are driven by falling water.

HYDROELECTRICITY. Electricity production by water-powered turbine generator.

HYDROLOGY. The science dealing with the properties, distribution, and circulation of water and snow.

HYDROPOWER. Power by falling water.

INSULATION. A substance that insulates is one that can slow down the flow of heat or sound.

INTERNAL COMBUSTION ENGINE. Energy is supplied by a burning fuel which is directly transformed into mechanical energy by controlled combustion.

JOULE. A metric unit of work or energy; the energy produced by a force of one newton operating through a distance of one meter.

KILOCALORIE. Heat energy equal to 4.19×10^3 joules.

KILOVOLT (KV). 1,000 volts.

KILOWATT (KW). The unit of power equal to 1,000 watts, 3.413 BTUs, or 1,341 horsepower. Roughly, the power of one kw is capable of raising the temperature of a pound (pint) of water $1^{\circ}F$ in one second.

KILOWATT-HOUR (KWH). The amount of work or energy delivered during the steady consumption of one kilowatt of power for a period of one hour; equivalent to 3.412 BTUs.

LIGHT. Radiant energy which an observer can see.

LIQUIFIED NATURAL GAS (LNG). Natural gas that has been changed into a liquid by cooling to about -260°F (-160°C) at which point it occupies about 1/600 of its gaseous volume at normal atmospheric pressure; thus, the cost of shipping and storage is reduced.

MECHANICAL ENERGY. The kind of energy that is released to make objects move.

MEGAWATT (MW) A unit of power equal to 1,000 kilowatts or one million watts.

METHANE. Colorless, nonpoisonous, and flammable gaseous hydrocarbon; emitted by marshes and by dumps undergoing decomposition.

NATURAL GAS. Naturally-occuring mixtures of hydrocarbon gases and vapors occurring naturally in certain geologic formations; usually found associated with oil.

NONRENEWABLE RESOURCES. Depletable energy resources such as the fossil fuels - coal, gas and oil.

NUCLEAR ELECTRIC POWER PLANT. One in which heat for raising steam is provided by fission rather than combustion of fossil fuel.

NUCLEAR (ATOMIC) FUEL. Material containing fissionable uranium of such composition and enrichment that, when placed in a nuclear reactor, will support a self-sustaining fission chain reaction and produce heat in a controlled manner for process use.

NUCLEAR POWER. Electric power produced from a power plant by converting the energy obtained from nuclear reaction.

NUCLEAR REACTION. A reaction involving a change in an atomic nucleus, such a fission, fusion, neutron capture, or radioactive decay, as distinct from a chemical reaction, which is limited to changes in electron structure surrounding the nucleus.

OFF-PEAK. Energy supplied during periods of relatively low system demands.

OIL SHALE. Sedimentary rock containing solid organic matter (kerogen) that yields substantial amounts of oil when heated to high temperatures.

OIL SPILL. The accidental discharge of oil into oceans, bays, or inland waterways. Methods of oil spill control include chemical dispersion, combustion, mechanical containment, and absorption.

OPEC (ORGANIZATION OF PETROLEUM EXPORTING COUNTRIES). An organization of countries in the Middle East, North Africa, and South America which aims at developing common oil-marketing policies.

PEAKING. Power plant operation to meet the highest portion of the daily load.

PEAKING CAPABILITY. The maximum peak load that can be supplied by a generating unit, station, or system in a stated period of time. For a hydroproject, the peaking capability would be equal to the maximum plant capability only under favorable pool and flow conditions. Often the peaking capability may be less due to reservoir drawdown or tailwater encroachment.

POWER. The time rate at which work is done. If an amount of work (w) is done in time (t) the power or rate of doing work is $P = w/t$. Power will be obtained in watts if w is expressed joules and t in seconds.

PUMPED HYDROELECTRIC STORAGE. The only means now available for the large-scale storage of electrical energy. Excess electricity produced during periods of low demand is used to pump water up to a reservoir. When demand is high, the water is released to operate a hydroelectric generator. Pumped energy storage only returns about 66 percent of the electrical energy put into it, but costs less than an equivalent generating capacity.

PUMPED STORAGE PLANT. A hydroelectric power plant which generates electric energy for peak load use by utilizing water pumped into a elevated storage reservoir during off-peak periods.

R-VALUE. Thermal resistance; computed by the conductivity divided into one. The measure of resistance to heat flow.

RECLAMATION. Act of process of reclaiming; for example, strip-mined land should be reclaimed -- replanted and leveled.

RENEWABLE RESOURCES. Nondepletable resources; for example, the sun.

RESERVES. The amount of a natural resource known to exist and expected to be recovered by present-day techniques.

RESOURCES. The estimated total quantity of a natural resource such as minerals in the ground; includes undiscovered mineral reserves.

SECOND LAW OF THERMODYNAMICS. One of the two "limit" laws which govern the conversion of energy. Referred to here as the "heat tax", it can be stated in several equivalent forms, all of which describe the inevitable passage of some energy from useful to a less useful form in any energy conversion.

SOLAR CELL. A photovoltaic cell which converts radiant energy from the sun into electrical energy.

SOLAR ENERGY. Radiation energy from the sun falling upon the earth's surface.

SOLID WASTE. Useless, unwanted, or discarded material with insufficient liquid content to be free flowing.

STATIC ELECTRICITY. Electricity at rest.

STEAM-ELECTRIC PLANT. A plant in which the prime movers (turbines) connected to the generators are driven by steam.

STOCKPILE. A storage pile or reserve supply of an essential raw material; for example, coal is stockpiled in the open air for storage purposes.

STRIP-mining. A process in which rock and topsoil strata overlying ore or fuel deposits are scraped away by mechanical shovels. Also known as surface mining.

TECHNOLOGY. Applied science.

THERMAL EFFICIENCY. The ratio of the electric power produced by a power plant to the amount of heat produced by the fuel; a measure of the efficiency with which the plant converts thermal to electrical energy.

THERMAL ENERGY. The total potential and kinetic energy associated with the random motions of the particles of a material.

thermal plant. A generating plant which converts heat energy to electrical energy. Such plants may burn coal, gas, oil, or use nuclear energy to produce thermal energy.

THERMAL POLLUTION. Degradation of water quality by the introduction of a heated effluent. Primarily a result of the discharge of cooling waters from industrial processes, particularly from electrical power generation.

THERMODYNAMICS. The science and study of the relationship between heat and mechanical work.

TRANSMISSION. The act or process of transporting electric energy in bulk from a source or sources of supply to other utility systems.

TRANSMISSION LINES. Wires or cables through which high voltage electric power is moved from point to point.

TURBINE. A motor, the shaft of which is rotated by a stream of water, steam, air, or fluid from a nozzle and forced against the blades of a wheel.

VAPOR. The words vapor and gas are often used interchangeably. Vapor is more frequently used for a substance which, though present in the gaseous phase, generally exists as a solid or liquid at room temperature. Gas is more frequently used for a substance that generally exists in the gaseous phase at room temperature.

VAPORIZATION. The change of a substance from a liquid or solid state to the gaseous state. One of three contributing factors to air pollution; the other are attrition and combustion.

VOLT. The unit of electromotive force. It is the difference in potential required to make a current flow through a resistance.

VOLTAGE. The amount of force employed to move a quantity of electricity; measured in volts.

WATER VAPOR. Water in the form of a gas.

WATT. (W). A unit of measure for electric power equal to the transfer of one joule of energy per second. The watt is the unit of power most often associated with electricity (1 horsepower = 746 watts) determined by multiplying reauired volts by required amperes (volts x amps = watts).

WEATHERSTRIPPING. Reduces the rate of air infiltration by making sure that all doors and windows fit their frames snugly.

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